

## **Station D**

**\*\*Record Only the sample letter(s) that apply. If none apply, record “None”\*\***

**18. Which sample(s) are Intrusive?**

Record letter(s) (A-E) or “None” from samples that apply

**19. Which sample(s) are Extrusive?**

Record letter(s) (A-E) or “None” from samples that apply

**20. Which sample(s) are Aphanitic?**

Record letter(s) (A-E) or “None” from samples that apply

**21. Which sample(s) are Phaneritic?**

Record letter(s) (A-E) or “None” from samples that apply

**22. Which sample(s) are Holohyaline?**

Record letter(s) (A-E) or “None” from samples that apply

**23. Which sample(s) contain Vesicles?**

Record letter(s) (A-E) or “None” from samples that apply

## **Station E**

**Sample X is a dark green metamorphic rock with dark red crystals**

**24. Are all of the samples at this station Metamorphic?**  
Record Yes or No

**25. Which sample might have been a Parent Rock to Sample X?**

Record letter (A-E)

**26. What Feature or Property makes you think this?**

**27. What is the Dark Red Mineral in sample X?**

**28. What is the General Name we give to metamorphic rocks like sample X?**

## **Station F**

A small sample of each of these minerals was specially prepared and inserted in a testing device. The device applied electric current to the mineral sample while monitoring it for movement. The data was graphed with vibration on the Y-Axis, and time on the X-Axis

**29. Which sample was used to create Graph I?**

Record letter (A-D)

**30. What is the name for this property?**

**31. What mineral is sample A?**

**32. What mineral is sample B?**

**33. What mineral is sample C?**

**34. What mineral is sample D?**

**35. Which sample has the highest hardness?**

Record letter (A-D)

**36. Which sample is a sulfide?**

Record letter (A-D)

## **Station G**

**Record the Sample Letter followed by the Sample Name for the sample Best displaying the following Lusters**

**37. Pearly Luster**

**38. Metallic**

**39. Silky**

**40. Vitreous**

**41. Greasy**

## **Station H**

**An experiment was conducted using sample A.  
Its volume was determined to be 100 cm<sup>3</sup>.  
Its weight was determined to be 450g.**

**42. Based on these results, what is the Specific Gravity of Sample A?**

Record a Number with Units

**43. When compared to the normal S.G. of this mineral, is the experimental value too high or too low?**

Record Too high or Too low

**(44-47) Rank the samples by S.G starting with the highest ending with the lowest. List the corresponding Mineral name on your answer sheet**

**44. Mineral name of sample with Highest S.G.**

**45.**

**46.**

**47. Mineral name of sample with Lowest S.G.**

## **Station I**

**(48-52) Using Bowens Reaction series, rank these samples beginning with First to crystallize, ending with the Last.**

**List the corresponding Sample letter, followed by it's name on your answer sheet**

- 48. Sample letter, mineral name (First to crystallize)**
- 49. Sample letter, mineral name**
- 50. Sample letter, mineral name**
- 51. Sample letter, mineral name**
- 52. Sample letter, mineral name (Last to crystallize)**

**53. How many of these samples contain Silica?**

Record the number (0-5) of included samples that apply

**54. How many of these samples are Phyllosilicates?**

Record the number (0-5) of included samples that apply

## **Station J**

**Record the Sample Letter followed by the Sample Name for All sample(s) that can be classified as follows. If none apply write “None”**

**55. Sulfide**

**56. Sulfate**

**57. Oxide/Hydroxide**

**58. Native Element**

**59. Halide**

**60. Carbonate**

**61. Silicate**

## **Station K**

**Record the Sample Letter followed by the Sample Name for All sample(s) that show the following Cleavage. If none apply write “None”**

**62. No Cleavage**

**63. One direction**

**64. Two directions, all at 90°**

**65. Two directions, none at 90°**

**66. Three directions, all at 90°**

**67. Three directions, none at 90°**

## **Station L**

**The streak of this sample is reddish-brown in some areas, and white in others**

**68. What Two minerals compose this sample?**

**69. What Environment did this form in?**

- A. Desert
- B. Tundra
- C. Ocean
- D. Plains

**70. Could this sample have been found in Australia?**

Record Yes or No

**71. How old might this sample be?**

- A. 50 million years
- B. 300 million years
- C. 650 million years
- D. 1.5 Billion years

**72. What is this sample?**

Record the general name for this type of deposit/formation

## **Station M**

**73. Are any of these samples soluble in water?**

Record Yes or No

**74. What is the crystal shape in sample E?**

- A. Cubic
- B. Hexagonal
- C. Monoclinic
- D. Orthorhombic

**75. Which sample shows “Hopper” Crystals?**

Record letter

**76. What material is most likely responsible for the color in samples A&C?**

- A. Calcium
- B. Lithium
- C. Iron
- D. Bacteria

**77. How would you describe the Break of sample A?**

- A. Cubic cleavage
- B. Basal cleavage
- C. Splintery fracture
- D. Uneven

**78. How would you describe the Break of sample B?**

- A. Cubic cleavage
- B. Basal cleavage
- C. Splintery fracture
- D. Uneven

## **Station N**

**79. Are all of these samples Metamorphic?**

Record Yes or No

**(80-82) Identify each sample, note if it shows foliation.**

**80. Sample A**

**81. Sample B**

**82. Sample C**

## **Station O**

**Record the Sample Letter followed by the Sample Name for the sample that can be best classified as follows.**

- 83. Silky Luster**
- 84. Pearly Luster**
- 85. Waxy Luster**
- 86. Basal Cleavage**
- 87. Would react to acid**

## **Station P**

**(88-99) Identify as many samples as possible**

## **Station Q**

**100. List Four Minerals Present in any of the samples at this station**

**(101-104) Rank each sample by the speed it cooled.  
Begin with First to crystallize, end with the Last.**

**101. Sample letter, rock name (Cooled fastest)**

**102. Sample letter, rock name**

**103. Sample letter, rock name**

**104. Sample letter, rock name (Cooled slowest)**

## **Station R**

**Record the Sample Letter followed by the Sample Name for the sample that can be best classified by the following**

**105. Bladed Crystals**

**106. Radiating Crystals**

**107. Elongated Crystals**

**108. Tabular Crystals**

**109. Which mineral is the Softest?**

Record the *Mineral Name*

**110. Which mineral has the Highest Specific Gravity?**

Record the *Mineral Name*

## **Station S**

**111. Which sample(s) is/are Plagioclase?**

Record letter(s) (A-E) or “None” from samples that apply

**112. Which sample(s) is/are Orthoclase?**

Record letter(s) (A-E) or “None” from samples that apply

**113. Which sample(s) is/are Hornblende?**

Record letter(s) (A-E) or “None” from samples that apply

**114. Which sample(s) is/are Augite?**

Record letter(s) (A-E) or “None” from samples that apply

**115. Does sample E show Monoclinic Crystals?**

Record Yes or No

**116. How many directions of Cleavage are visible in sample C?**

Record the number

## **Station T**

**Record the corresponding letter(s) to all sample(s) that could be described by the following terms**

**117. Pyritohedral Crystal**

**118. Cubic Crystal**

**119. Sulfide**

**120. Contains Iron**

**121. Metallic Luster**

**122. What Two Minerals are present in sample C?**

# National Science Olympiad 2013

## Rotor Egg Drop B

Enter # of Teams in Cell D1 -->		60	Co	1. All Co	2. Mass	3. Need	4. Egg w	5. Partic	6. Disqu	Flight Time			Final Score				
Team	column E, G, H, I, & J. The default value in column E	State								7. Tm	8. Tm	9. Tm	Score	Tier	Tiebr	Rank	Point
1	Winston Churchill Middle School	CA	Y	12	N	N	N	N	N	7.37	7.35	7.35	7.35	1	0	12	12
2	Muscatel Middle School	CA	N	29	N	N	N	N	N	7.25	7.07	7.16	7.16	3	0	46	46
3	Carnage Middle School	NC	Y	38	N	N	N	N	N	5.78	5.72	5.94	5.78	1	0	27	27
4	Piedmont Middle School	NC	N	23	N	N	N	N	N	3.32	3.47	3.31	3.32	3	0	53	53
5	Meads Mill Middle School	MI	Y	9	N	N	N	N	N	9.31	9.25	9.13	9.25	1	0	2	2
6	Lakeshore Middle School	MI	Y	11	N	N	N	N	N	9.19	9.06	9.16	9.16	1	0	3	3
7	Paul J. Gelinas Junior High School	NY	Y	18	N	N	N	N	N	6.43	6.47	6.59	6.47	1	0	21	21
8	Eagle Hill Middle School	NY	N	13	N	Y	N	N	N	5.94	5.75	5.81	5.81	4	0	54	54
9	Daniel Wright Jr. High School	IL	Y	11	N	N	N	N	N	8.16	8.00	7.97	8.00	1	0	5	5
10	Marie Murphy Middle School	IL	Y	8	N	N	N	N	N	7.28	7.15	7.16	7.16	1	0	15	15
11	Shady Side Academy	PA	Y	14	N	N	N	N	N	7.88	7.56	7.75	7.75	1	-1	8	8
12	Strath Haven Middle School	PA	Y	19	N	N	N	N	N	6.75	6.63	6.72	6.72	1	0	18	18
13	Solon Middle School	OH	Y	13	N	N	N	N	N	8.03	8.00	8.00	8.00	1	-1	6	6
14	Mentor Memorial Middle School	OH	Y	27	N	N	N	N	N	7.03	7.06	7.03	7.03	1	0	16	16
15	Beckendorff Junior High School	TX	N	21	N	N	N	N	N	7.71	7.69	7.50	7.69	3	0	43	43
16	Riverwood Middle School	TX	Y	10	N	N	N	N	N	9.31	9.32	9.35	9.32	1	0	1	1
17	J.C. Booth Middle School	GA	N	15	N	N	N	N	N	8.22	7.94	8.00	8.00	3	0	41	41
18	Dodgen Middle School	GA	Y	13	N	N	N	N	N	8.03	7.69	7.75	7.75	1	0	7	7
19	Ladue Middle School	MO	Y	65	N	N	N	N	N	2.47	2.88		2.68	1	0	37	37
20	Pembroke Hill Middle School	MO	Y	12	N	N	N	N	N	6.41	6.19	6.16	6.19	1	0	24	24
21	Orlando Science Schools	FL	Y	42	N	N	N	N	N	6.88	6.69	6.69	6.69	1	-1	20	20
22	Trinity Preparatory School	FL	N	13	N	N	N	N	N	5.90	5.90	5.9	5.90	3	0	48	48
23	Thomas Jefferson Middle School	IN	Y	14	N	Y	N	N	N	5.81	5.88	5.87	5.87	2	0	38	38
24	The Stanley Clark School	IN	Y	19	N	N	N	N	N	5.03	5.18	5.10	5.10	1	0	30	30
25	Preston Middle School	CO	N	25	N	N	N	N	N	5.93	5.74	5.81	5.81	3	0	49	49
26	Homeschool Science Colorado	CO	Y	17	N	N	N	N	N	6.00	5.50	5.85	5.85	1	0	26	26
27	Auburn Junior High	AL	N	12	N	N	N	N	N	7.50	7.35	7.38	7.38	3	0	44	44
28	Canyon Park Junior High School	WA	Y	41	N	N	N	N	N	4.81	4.57	4.66	4.66	1	0	34	34
29	Leawood Middle School	KS	N	21	N	Y	N	N	N	4.19	4.09		4.14	4	0	58	58
30	Wachter Middle School	ND	N	14	N	N	N	N	N	7.87	7.53	7.72	7.72	3	0	42	42
31	Albuquerque Area Home Schoolers	NM	N	74	N	Y	N	N	N	4.41	4.34		4.38	4	0	57	57
32	Hamilton Middle School	WI	Y	9	N	N	N	N	N	9.06	9.00	9.16	9.06	1	0	4	4
33	HB DuPont Middle School	DE	Y	49	N	N	N	N	N	4.81	4.81	4.81	4.81	1	0	32	32
34	Longfellow Middle School	VA	Y	12	N	N	N	N	N	7.75	7.59	7.59	7.59	1	0	9	9
35	Community Middle School	NJ	Y	11	N	N	N	N	N	7.56	7.44	7.50	7.50	1	0	11	11
36	Bearden Middle School	TN	Y	16	N	N	N	N	N	7.13	7.22	7.22	7.22	1	0	13	13
37	Russell Independent Middle School	KY	N	11	N	N	N	N	N	6.72	6.53	6.41	6.53	3	0	47	47
38	Corvallis Middle School	MT	Y	10	N	N	N	N	N	5.63	5.53	5.62	5.62	1	0	28	28
39	Mission Middle School	NE	Y	28	N	Y	N	N	N	5.04	5.04	5.04	5.04	2	0	39	39
40	North Bethesda Middle School	MD	N	35	N	Y	N	N	N	5.19	5.10	5.09	5.10	4	0	55	55
41	AW Coolidge Middle School	MA	Y	14	N	N	N	N	N	6.75	6.62	6.69	6.69	1	0	19	19
42	Fairfield Junior High	UT	Y	6	N	N	N	N	N	6.96	6.97	6.91	6.96	1	0	17	17
43	Paragon Science Academy	AZ	Y	28	N	N	N	N	N	6.44	6.15	6.47	6.44	1	0	22	22
44	Highlands Intermediate School	HI	N	20	N	N	N	N	N	7.47	7.28	7.29	7.29	3	0	45	45
45	Friedell Middle School	MN	Y	40	N	N	N	N	N	5.78	5.38	5.38	5.38	1	0	29	29
46	Germantown Middle School	MS	Y	49	N	N	N	N	N	6.50	6.09		6.30	1	0	23	23
47	St. Joseph's Catholic School	ID	N	49	N	N	N	N	N	5.03	4.94	4.81	4.94	3	0	50	50
48	Lyme/Old Lyme Middle School	CT	Y	13	N	N	N	N	N	7.56	7.59	7.63	7.59	1	-1	10	10
49	St. John Berchmans Catholic School	LA	Y	11	N	N	N	N	N	5.31	5.04	4.94	5.04	1	0	31	31

Direct all questions to

# National Science Olympiad 2013

## Rotor Egg Drop B

Enter # of Teams in Cell D1 -->		60	Final Ranking	
Team	column E, G, H, I, & J. The default value in column E	State	Rank	Team Name
1	Winston Churchill Middle School	CA	1	Riverwood Middle School
2	Muscatel Middle School	CA	2	Meads Mill Middle School
3	Carnage Middle School	NC	3	Lakeshore Middle School
4	Piedmont Middle School	NC	4	Hamilton Middle School
5	Meads Mill Middle School	MI	5	Daniel Wright Jr. High School
6	Lakeshore Middle School	MI	6	Solon Middle School
7	Paul J. Gelinas Junior High School	NY	7	Dodgen Middle School
8	Eagle Hill Middle School	NY	8	Shady Side Academy
9	Daniel Wright Jr. High School	IL	9	Longfellow Middle School
10	Marie Murphy Middle School	IL	10	Lyme/Old Lyme Middle School
11	Shady Side Academy	PA	11	Community Middle School
12	Strath Haven Middle School	PA	12	Winston Churchill Middle School
13	Solon Middle School	OH	13	Bearden Middle School
14	Mentor Memorial Middle School	OH	14	Catlin Gabel School
15	Beckendorff Junior High School	TX	15	Marie Murphy Middle School
16	Riverwood Middle School	TX	16	Mentor Memorial Middle School
17	J.C. Booth Middle School	GA	17	Fairfield Junior High
18	Dodgen Middle School	GA	18	Strath Haven Middle School
19	Ladue Middle School	MO	19	AW Coolidge Middle School
20	Pembroke Hill Middle School	MO	20	Orlando Science Schools
21	Orlando Science Schools	FL	21	Paul J. Gelinas Junior High School
22	Trinity Preparatory School	FL	22	Paragon Science Academy
23	Thomas Jefferson Middle School	IN	23	Germantown Middle School
24	The Stanley Clark School	IN	24	Pembroke Hill Middle School
25	Preston Middle School	CO	25	Casady School
26	Homeschool Science Colorado	CO	26	Homeschool Science Colorado
27	Auburn Junior High	AL	27	Carnage Middle School
28	Canyon Park Junior High School	WA	28	Corvallis Middle School
29	Leawood Middle School	KS	29	Friedell Middle School
30	Wachter Middle School	ND	30	The Stanley Clark School
31	Albuquerque Area Home Schoolers	NM	31	St. John Berchmans Catholic School
32	Hamilton Middle School	WI	32	HB DuPont Middle School
33	HB DuPont Middle School	DE	33	Mount Vernon Middle School
34	Longfellow Middle School	VA	34	Canyon Park Junior High School
35	Community Middle School	NJ	35	Riverton Middle School
36	Bearden Middle School	TN	36	Teeland Middle School
37	Russell Independent Middle School	KY	37	Ladue Middle School
38	Corvallis Middle School	MT	38	Thomas Jefferson Middle School
39	Mission Middle School	NE	39	Mission Middle School
40	North Bethesda Middle School	MD	40	Lisa Academy
41	AW Coolidge Middle School	MA	41	J.C. Booth Middle School
42	Fairfield Junior High	UT	42	Wachter Middle School
43	Paragon Science Academy	AZ	43	Beckendorff Junior High School
44	Highlands Intermediate School	HI	44	Auburn Junior High
45	Friedell Middle School	MN	45	Highlands Intermediate School
46	Germantown Middle School	MS	46	Muscatel Middle School
47	St. Joseph's Catholic School	ID	47	Russell Independent Middle School
48	Lyme/Old Lyme Middle School	CT	48	Trinity Preparatory School
49	St. John Berchmans Catholic School	LA	49	Preston Middle School

Direct all questions to

# National Science Olympiad 2013

## Rotor Egg Drop B

Enter # of Teams in Cell D1 -->		60	State	1. All Co	2. Mass	3. Need	4. Egg w	5. Partic	6. Disqu	Flight Time			Final Score				
Team	column E, G, H, I, & J. The default value in column E									7. Tm	8. Tm	9. Tm	Score	Tier	Tiebr	Rank	Point
50	Our Lady of Mercy	RI	N	15	N	N	N	N	3.94	3.97	3.84	3.94	3	0	51	51	
51	Teeland Middle School	AK	Y	15	Y	N	N	N	5.09	4.94	5.03	3.03	1	0	36	36	
52	Bell Street Middle School	SC	N	36	N	Y	N	N	4.81	4.81	4.72	4.81	4	0	56	56	
53	Catlin Gabel School	OR	Y	10	N	N	N	N	7.22	7.13		7.18	1	0	14	14	
54	Lisa Academy	AR	Y	34	N	Y	N	N	5.06	4.88	5.00	5.00	2	0	40	40	
55	Hyde Park Middle School	NV	N	26	N	Y	N	N	3.28	3.03	3.09	3.09	4	0	60	60	
56	Casady School	OK	Y	12	N	N	N	N	6.19	5.91	6.13	6.13	1	0	25	25	
57	Riverton Middle School	WY	Y	40	N	N	N	N	4.47	4.16	4.19	4.19	1	0	35	35	
58	Mount Vernon Middle School	IA	Y	20	N	N	N	N	4.75	4.88	4.71	4.75	1	0	33	33	
59	Yankton Middle School	SD	N	12	N	N	N	N	4.56	3.60		3.60	3	0	52	52	
60	Medomak Middle School	ME	N	83	N	Y	N	N	3.78	3.72	3.69	3.72	4	0	59	59	

**National Science Olympiad 2013**  
**Rotor Egg Drop B**

Enter # of Teams in Cell D1 -->		60	Final Ranking	
Team	column E, G, H, I, & J. The default value in column E	State	Rank	Team Name
50	Our Lady of Mercy	RI	50	St. Joseph's Catholic School
51	Teeland Middle School	AK	51	Our Lady of Mercy
52	Bell Street Middle School	SC	52	Yankton Middle School
53	Catlin Gabel School	OR	53	Piedmont Middle School
54	Lisa Academy	AR	54	Eagle Hill Middle School
55	Hyde Park Middle School	NV	55	North Bethesda Middle School
56	Casady School	OK	56	Bell Street Middle School
57	Riverton Middle School	WY	57	Albuquerque Area Home Schoolers
58	Mount Vernon Middle School	IA	58	Leawood Middle School
59	Yankton Middle School	SD	59	Medomak Middle School
60	Medomak Middle School	ME	60	Hyde Park Middle School

## NATIONAL SCIENCE OLYMPIAD 2013 ~ DIVISION B: SHOCK VALUE

## PART 1: GENERAL QUESTIONS ELECTRICITY AND MAGNETISM THERE MAY BE MORE THAN ONE ANSWER TO EACH QUESTION.

1. Look at the picture of the bulb, battery and wire alignments below. Which bulb(s) are lit?

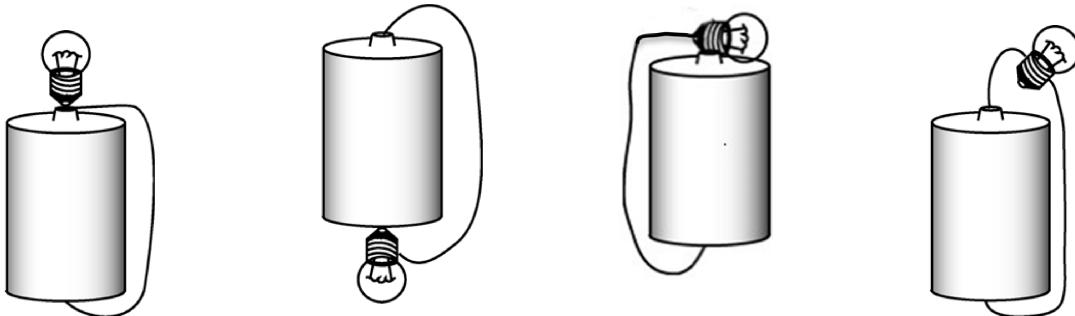
**B & C**

a.

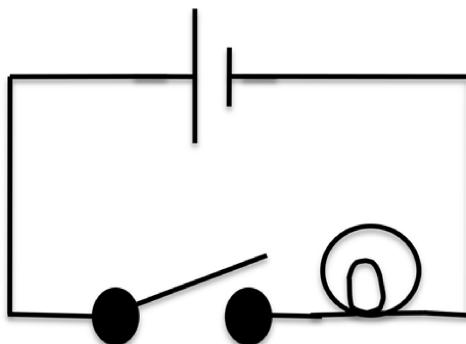
b

c

d.



2. Which of the following are insulators?  
 a) Copper    b) Brass    c) Aluminum    d) Gold    **e) Rubber**    **f) Glass**  
 g) Sea Water
3. Given a 60-W light bulb and a 100-W light bulb, each in a lamp that is plugged into the wall. Which one will have more current passing through it?  
 a) 60-W light bulb    **b) 100-W light bulb**    c) Both are the same
4. Both 12 gage wire and 14 gage wire are used in the circuits in the home. Which wire is the better conductor?  
**a) 12 gage wire**    b) 14 gage wire    c) Both are the same
5. Two wires have the same length and diameter. One is made of aluminum and the other of copper. Which one has the greater resistance?  
**a) aluminum**    b) copper    c) neither, they are both the same.
6. When the switch in the circuit at the right is closed, the light bulb will glow immediately. What is the average speed of the electrons along the wire?  
 a) The speed of sound waves in the wire.  
 b) The speed of light.  
**c) Less than a 1 cm/s.**  
 d) The electrons do not move at all.
7. Using the same circuit at the right. When the switch is open, what is the voltage across the light bulb?  
**a) Zero.**    b) the same as  $V_{\text{Battery}}$     c) depends on the resistance of the bulb.



8. Which of the following is correct for a light bulb?
- a) The light bulb has no resistance.
  - b) The resistance of the bulb decreases as it starts to glow.
  - c) The resistance of the bulb stays constant as the voltage increases.
  - d) The resistance of the bulb increases as the voltage increases.**
  - e) None of the above.

For problems #9 – 12: You are given two resistors.  $R_A > R_B$

9. When the resistors are wired in series to a battery, which one will have the greater current passing through it?  
a) A      b) B      **c) Both will have the same.**
10. When the resistors are wired in series to a battery, which one will have the greater voltage drop across it?  
**a) A**      b) B      c) Both will have the same.
11. When the resistors are wired in parallel to a battery, which one will have the greater current passing through it?  
a) A      **b) B**      c) Both will have the same.
12. When the resistors are wired in parallel to a battery, which one will have the greater voltage drop across it?  
a) A      b) B      **c) Both will have the same.**

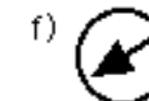
Match the descriptions in the left column with the terms in the right column.

- |  |                      |
|--|----------------------|
| 13. A device that converts chemical energy into electrical energy.   | <b>j) Battery</b>    |
| 14. Device used to measure current.                                  | <b>g) ammeter</b>    |
| 15. A device that converts electrical energy into mechanical energy. | <b>b) motor</b>      |
| 16. Unit of measure for current.                                     | <b>i) ampere</b>     |
| 17. Unit of measure for resistance.                                  | <b>h) ohm</b>        |
| 18. Device that converts electrical energy into radiant energy.      | <b>f) light bulb</b> |
| 19. Device used to measure potential difference.                     | <b>d) voltmeter</b>  |
| 20. Term for a device that opposes the movement of electrons         | <b>e) resistor</b>   |

21. Which of the following describes a secondary cell?
- a) **It can be recharged.**  
b) It is only used as a backup or emergency battery.  
c) It can only be used in series with a primary cell.  
d) All the above.  
e) None of the above.
22. Which of the materials listed can be picked up by a magnet?
- a) Gold    b) Silver    **c) Iron**    d) Rubber    e) Glass    f) Copper    g) Aluminum
23. The source of all magnetism is:
- a) tiny pieces of iron.  
b) tiny domains of aligned atoms  
c) ferromagnetic materials  
**d) moving electrical charge**  
e) none of the above
24. A chain of paperclips is hanging from the South pole of a magnet. The induced pole in the bottom of the lowest paper clip is a:
- a) North pole    **b) South pole**    c) could be either N or S
25. A copper penny is attracted to which pole of a magnet?
- a) The North pole of a magnet.  
b) The South pole of a magnet.  
c) Either the North pole or the South pole of a magnet.  
**d) Neither the North pole nor the South pole of a magnet.**
26. Which of the following is true for a bar magnet that has been cut in half?
- a) One piece will be only a North pole and the other piece only a South pole.  
**b) Each piece will be a magnet with both a North pole and a South pole.**  
c) Both pieces will be only a South pole.  
d) Both pieces will be only a North pole.  
e) The pieces will no longer be magnetized.
27. A compass is actually a small magnet placed on a pivot. Which pole of the compass points towards the Earth's Geographic North pole where the polar bears live?
- a) South    **b) North**    c) South Seeking Pole    d) Neither
28. An non magnetized iron bar is placed on the table, and a bar magnet is brought close to it. The iron bar ...
- a) will not be attracted to the bar magnet.  
b) will only be attracted to the south pole of the bar magnet.  
c) will only be attracted to the north pole of the bar magnet.  
**d) will be attracted to either pole of the bar magnet.**

**FOR REFERENCE THE TOP OF THE PAPER IS NORTH, THE BOTTOM OF THE PAPER IS SOUTH, THE LEFT SIDE IS WEST, THE RIGHT SIDE IS EAST, INTO THE PAPER TOWARDS THE FLOOR IS DOWN AND OUT OF THE PAPER TOWARDS THE CEILING IS UP.**

Use the choices illustrated below to answer questions #29-33



The compass is placed near pole "P" as shown at the right. Which way will the same compass point when it is placed...



29. at point "J"? e)



30. at point "K"? d)

31. at point "L"? d)

32. at point "M"? a)

33. Which pole of the magnet is at point "Q"?

a) North

b) South

c) Neither, the end is not a pole.

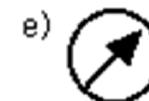
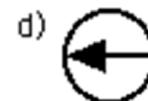
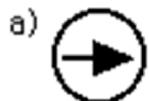
d) Can't tell

34. A compass is placed next to a wire that is oriented vertically so that it passes through the page as shown at the right. Which way is the current passing through the wire?



a) North b) South c) Up d) Down e) East f) There is no current

Use the compass directions "a" through "f" illustrated below to answer questions #35-37

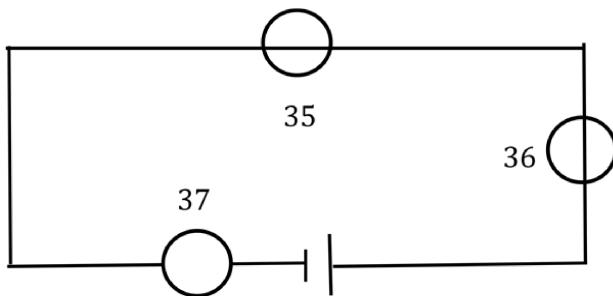


35-37 In the circuit shown at the right, a compass is placed either above or below the wire at the points indicated by #35, 36 and 37. Which way will the compass point in each case?

35. c)

36. d)

37. c)



**Use the following answers for questions #38 - 41.**

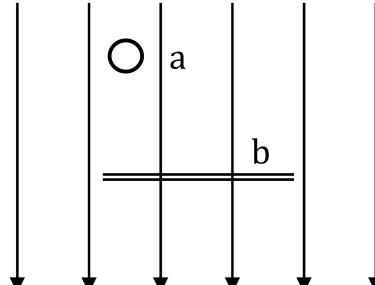
- a) North b) South c) East d) West e) Up f) Down g) None

38. In the drawing at the right the magnetic field is acting to the South. What is the direction of the force on wire "a" if the current (electron flow) is going Down into the page?

**c) East**

39. In the drawing at the right the magnetic field is acting to the South. What is the direction of the force on wire "b" if the current (electron flow) is going East?

**e) Up**



40. In the drawing at the right the magnetic field is acting into the page. What would be the direction of the force on an electron that is moving to the East? **b) South**

X X X X X

X X X X X

41. In the drawing at the right the magnetic field is acting into the page. What would be the direction of the force on a proton that is moving to the South? **c) East**

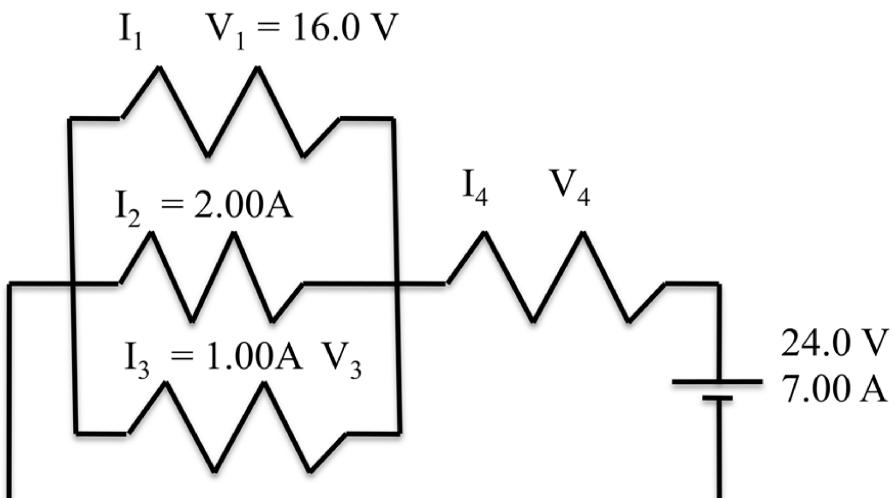
X X X X X

X X X X X

Use the drawing at the right to answer questions #42 - 45

42. What is  $I_1$ ?

- a) 1.00 A  
b) 2.00 A  
c) 3.00 A  
**d) 4.00 A**  
e) 7.00 A



43. What is  $V_3$ ?

- a) 4.0 V      b) 8.0 V      **c) 16.0 V**      d) 24.0 V      e) 40.0 V

44. What is  $I_4$ ?

- a) 1.00 A      b) 2.00 A      c) 3.00 A      d) 4.00 A      **e) 7.00 A**

45. What is  $V_4$ ?

- a) 4.0 V      **b) 8.0 V**      c) 16.0 V      d) 24.0 V      e) 40.0 V

Use the drawing at the right to answer questions #46 – 50.

46. What is the current passing through Resistor  $R_3$ ?

- a) 1.00 A
- b) 2.00 A**
- c) 4.00 A
- d) 7.50 A
- e) 4.00  $\Omega$

47. What is the voltage drop across Resistor  $R_3$ ?

- a) 30.0 V
- b) 16.0 V
- c) 8.0 V**
- d) 6.00 V
- e) None of these.

48. What is the current passing through the battery?

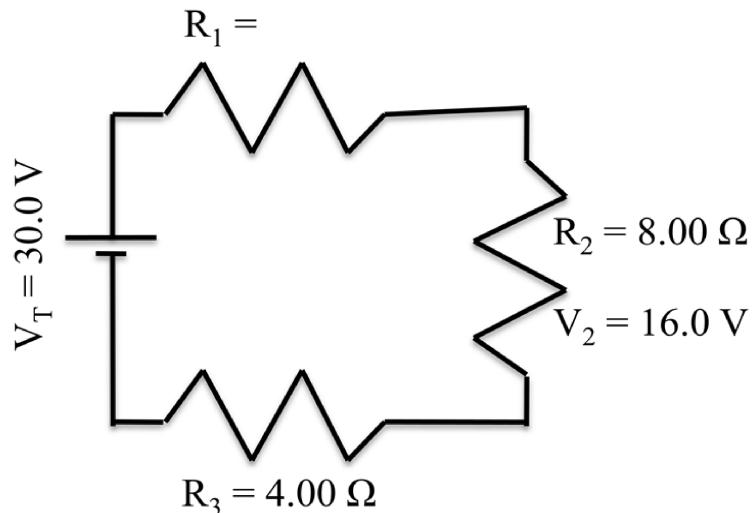
- a) 1.00 A
- b) 2.00 A**
- c) 4.00 A
- d) 7.50 A
- e) None of these.

49. What is the voltage drop across resistor  $R_1$ ?

- a) 30.0 V
- b) 16.0 V
- c) 8.0 V
- d) 6.00 V**
- e) None of these.

50. What is the total resistance of the external circuit?

- a) 4.00  $\Omega$
- b) 12.0  $\Omega$
- c) 15.0  $\Omega$**
- d) 30.0  $\Omega$
- e) None of these.



**PART #1 POINTS**

**/50**

**NATIONAL SCIENCE OLYMPIAD 2013 ~ DIVISION B: SHOCK VALUE****PART 2: LAB EXERCISES.**

1. Before you is a breadboard with a single circuit involving many resistors of three (3) distinct values. **THERE IS TAPE COVERING EACH RESISTOR EXCEPT ONE. DO NOT TRY TO REMOVE THE TAPE AND DO NOT REMOVE ANY OF THE RESISTORS!** (24 POINTS) FIRST TIE BREAKER.

In my storeroom I had the following types of resistors, but I only used three types of these in this circuit. Find and list the values of each resistor in the spaces below.

Brown Green Black Gold  
 Red Red Black Gold  
 Orange Orange Black Gold  
 Yellow Violet Black Gold

Green Blue Black Gold  
 Brown Black Brown Gold  
 Red Red Brown Gold

**THIS IS HOW THE RESISTORS ARE ARRANGED ON THE BREADBOARD.**

$R_4$	$R_6$	$R_7$	$R_{10}$
$R_3$	$R_5$	$R_9$	$R_{12}$
$R_2$	$R_8$		$R_{11}$
$R_1$			

**LIST YOUR ANSWERS BELOW (TWO POINTS EACH).**

$$R_1 = 220 \Omega$$

$$R_7 = 56 \Omega$$

$$R_2 = 220 \Omega$$

$$R_8 = 220 \Omega$$

$$R_3 = 220 \Omega$$

$$R_9 = 220 \Omega$$

$$R_4 = 220 \Omega$$

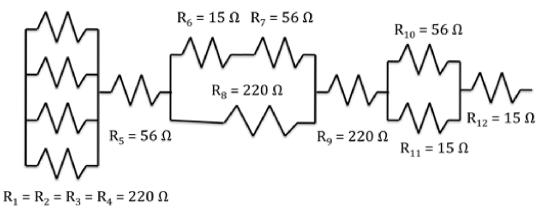
$$R_{10} = 56 \Omega \downarrow \text{ or } 15 \Omega \downarrow$$

$$R_5 = 56 \Omega$$

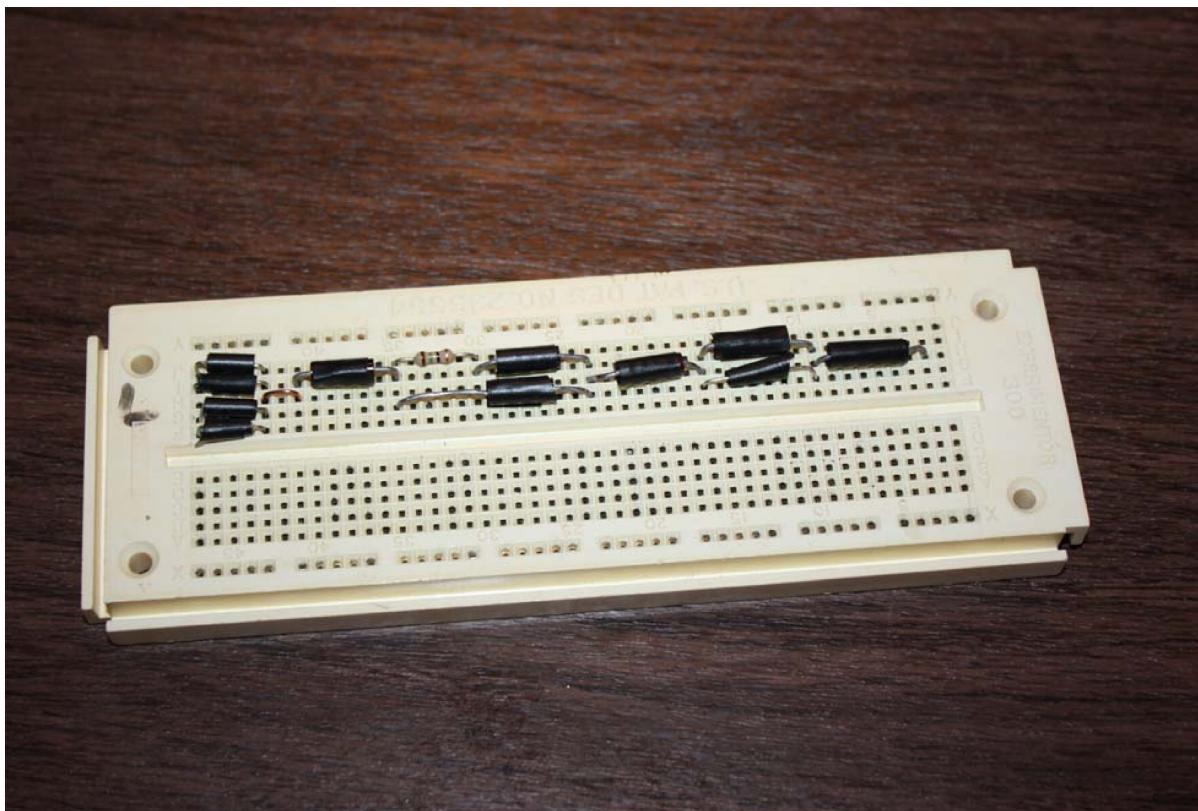
$$R_{11} = 15 \Omega \uparrow \text{ or } 56 \Omega \uparrow$$

$$R_6 = 15 \Omega$$

$$R_{12} = 15 \Omega$$

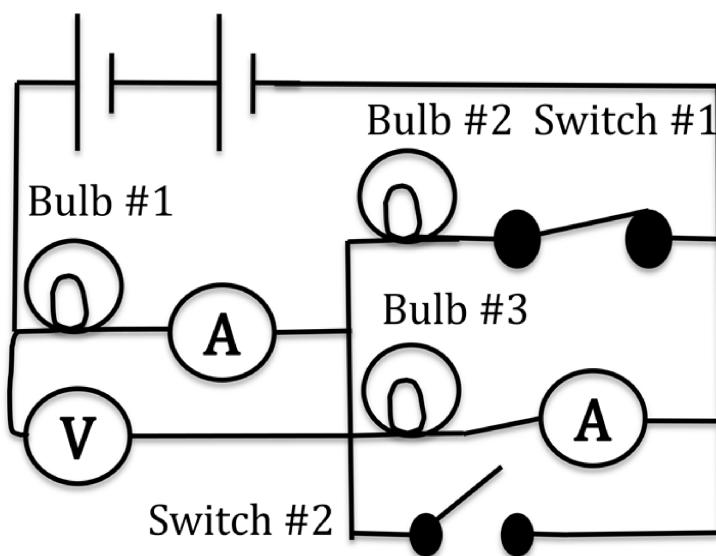
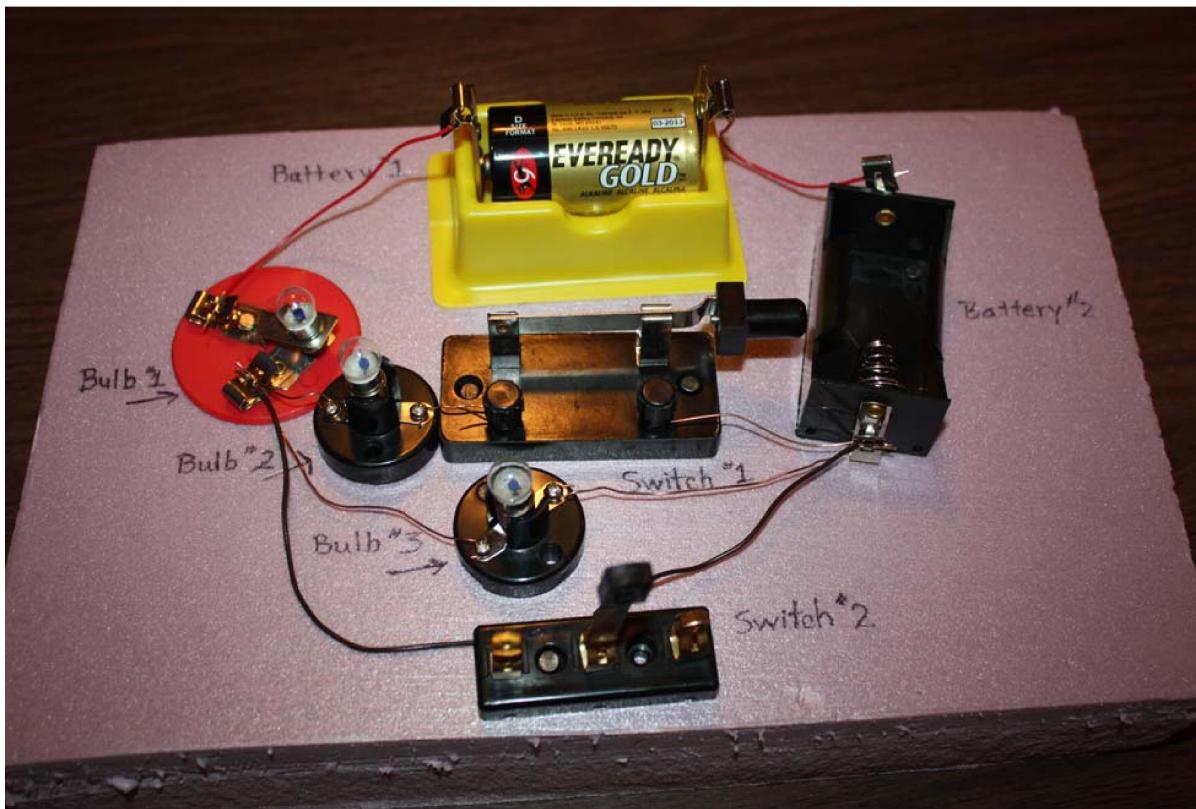


$R_{10}$  and  $R_{11}$  can be reversed. Either  
**56Ω and 15 Ω or 15 Ω and 56Ω**



**DO NOT MOVE ANY OF THE WIRES OR CHANGE THE POSITION OF ANY OF THE SWITCHES!**

2. Before you is a circuit with switches, identical light bulbs and a battery holder. Draw a schematic of the circuit as if the following were true. There are batteries in the holders that were wired properly in series. SECOND TIE BREAKER. (CIRCUIT 19 POINTS)
- There is a voltmeter placed to measure the voltage drop across Bulb #1.
  - There is an ammeter placed to measure the current passing through just bulb #1.
  - There is an ammeter placed to measure the current passing through just bulb #3.



One point for each proper symbol.

Eight points for the proper circuit. Some partial credit for parts of the circuit.

Note Battery Orientation!

Assuming that there are batteries in the battery holders and initially all the bulbs are lit, circle the correct answer for each of the following questions. (one point each)

IN THE SYSTEM SHOWN, WHICH BULB(S) WILL BE THE BRIGHTEST?

- a) **Bulb #1**   b) Bulb #2   c) Bulb #3   d) Bulb #2 & 3   e) All are the same.

IF ONLY SWITCH #1 IS OPENED, WHAT WILL HAPPEN TO THE CURRENT IN EACH BULB?

- |         |                   |                    |                  |                          |
|---------|-------------------|--------------------|------------------|--------------------------|
| Bulb #1 | a) Go to 0        | <b>b) Decrease</b> | c) Stay the same | d) Become greater        |
| Bulb #2 | <b>a) Go to 0</b> | b) Decrease        | c) Stay the same | d) Become greater        |
| Bulb #3 | a) Go to 0        | b) Decrease        | c) Stay the same | <b>d) Become greater</b> |

IF ONLY SWITCH #2 IS CLOSED, WHAT WILL HAPPEN TO THE BRIGHTNESS OF EACH BULB?

- |         |                  |                  |                  |                           |
|---------|------------------|------------------|------------------|---------------------------|
| Bulb #1 | a) Go out        | b) Become dimmer | c) Stay the same | <b>d) Become brighter</b> |
| Bulb #2 | <b>a) Go out</b> | b) Become dimmer | c) Stay the same | d) Become brighter        |
| Bulb #3 | <b>a) Go out</b> | b) Become dimmer | c) Stay the same | d) Become brighter        |

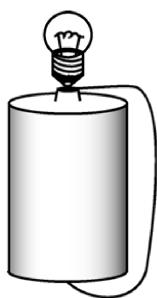
**PART 2** \_\_\_\_\_ /50 POINTS

# NATIONAL SCIENCE OLYMPIAD 2013 ~ DIVISION B: SHOCK VALUE

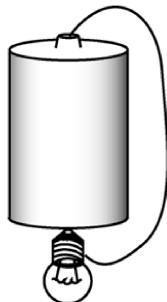
## PART 1: GENERAL QUESTIONS ELECTRICITY AND MAGNETISM THERE MAY BE MORE THAN ONE ANSWER TO EACH QUESTION.

1. Look at the picture of the bulb, battery and wire alignments below. Which bulb(s) are lit?

a.



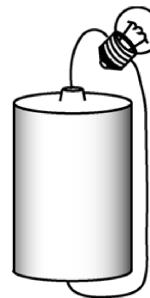
b



c



d.



- 2 Which of the following are insulators?

a) Copper    b) Brass    c) Aluminum    d) Gold    e) Rubber    f) Glass  
g) Sea Water

- 3 Given a 60-W light bulb and a 100-W light bulb, each in a lamp that is plugged into the wall. Which one will have more current passing through it?

a) 60-W light bulb    b) 100-W light bulb    c) Both are the same

- 4 Both 12 gage wire and 14 gage wire are used in the circuits in the home. Which wire is the better conductor?

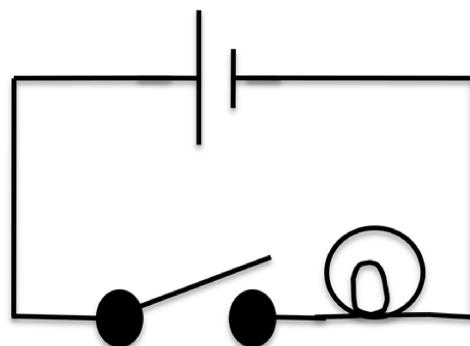
a) 12 gage wire    b) 14 gage wire    c) Both are the same

- 5 Two wires have the same length and diameter. One is made of aluminum and the other of copper. Which one has the greater resistance?

a) aluminum    b) copper    c) neither, they are both the same.

- 6 When the switch in the circuit at the right is closed, the light bulb will glow immediately. What is the average speed of the electrons along the wire?

a) The speed of sound waves in the wire.  
b) The speed of light.  
c) Less than a 1 cm/s.  
d) The electrons do not move at all.



- 7 Using the same circuit at the right. When the switch is open, what is the voltage across the light bulb?

a) Zero.    b) the same as  $V_{\text{Battery}}$     c) depends on the resistance of the bulb.

8. Which of the following is correct for a light bulb?
- a) The light bulb has no resistance.
  - b) The resistance of the bulb decreases as it starts to glow.
  - c) The resistance of the bulb stays constant as the voltage increases.
  - d) The resistance of the bulb increases as the voltage increases.
  - e) None of the above.

For problems #9 – 12: You are given two resistors.  $R_A > R_B$

9. When the resistors are wired in series to a battery, which one will have the greater current passing through it?
- a) A
  - b) B
  - c) Both will have the same.
10. When the resistors are wired in series to a battery, which one will have the greater voltage drop across it?
- a) A
  - b) B
  - c) Both will have the same.
11. When the resistors are wired in parallel to a battery, which one will have the greater current passing through it?
- a) A
  - b) B
  - c) Both will have the same.
12. When the resistors are wired in parallel to a battery, which one will have the greater voltage drop across it?
- a) A
  - b) B
  - c) Both will have the same.

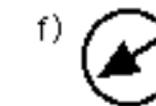
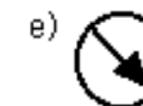
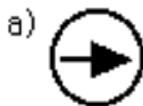
Match the descriptions in the left column with the terms in the right column.

- |  |               |
|--|---------------|
| 13. A device that converts chemical energy into electrical energy.   | a) Generator  |
| 14. Device used to measure current.                                  | b) Motor      |
| 15. A device that converts electrical energy into mechanical energy. | c) Ampmeter   |
| 16. Unit of measure for current.                                     | d) Voltmeter  |
| 17. Unit of measure for resistance.                                  | e) Resistor   |
| 18. Device that converts electrical energy into radiant energy.      | f) Light bulb |
| 19. Device used to measure potential difference.                     | g) Ammeter    |
| 20. Term for a device that opposes the movement of electrons         | h) Ohm        |
|  | i) Ampere     |
|  | j) Battery    |
|  | k) Volt       |

21. Which of the following describes a secondary cell?
  - a) It can be recharged.
  - b) It is only used as a backup or emergency battery.
  - c) It can only be used in series with a primary cell.
  - d) All the above.
  - e) None of the above.
22. Which of the materials listed can be picked up by a magnet?
  - a) Gold
  - b) Silver
  - c) Iron
  - d) Rubber
  - e) Glass
  - f) Copper
  - g) Aluminum
23. The source of all magnetism is:
  - a) tiny pieces of iron.
  - b) tiny domains of aligned atoms
  - c) ferromagnetic materials
  - d) moving electrical charge
  - e) none of the above
24. A chain of paperclips is hanging from the South pole of a magnet. The induced pole in the bottom of the lowest paper clip is a:
  - a) North pole
  - b) South pole
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25. A copper penny is attracted to which pole of a magnet?
  - a) The North pole of a magnet.
  - b) The South pole of a magnet.
  - c) Either the North pole or the South pole of a magnet.
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  - c) Both pieces will be only a South pole.
  - d) Both pieces will be only a North pole.
  - e) The pieces will no longer be magnetized.
27. A compass is actually a small magnet placed on a pivot. Which pole of the compass points towards the Earth's Geographic North pole where the polar bears live?
  - a) South
  - b) North
  - c) South Seeking Pole
  - d) Neither
28. An non magnetized iron bar is placed on the table, and a bar magnet is brought close to it. The iron bar ...
  - a) will not be attracted to the bar magnet.
  - b) will only be attracted to the south pole of the bar magnet.
  - c) will only be attracted to the north pole of the bar magnet.
  - d) will be attracted to either pole of the bar magnet.

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Use the choices illustrated below to answer questions #29-33



The compass is placed near pole "P" as shown at the right. Which way will the same compass point when it is placed...



29. at point "J"?

30. at point "K"?

31. at point "L"?

32. at point "M"?

33. Which pole of the magnet is at point "Q"?

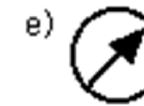
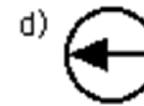
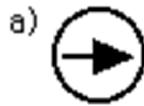
- a) North      b) South      c) Neither, the end is not a pole.      d) Can't tell

34. A compass is placed next to a wire that is oriented vertically so that it passes through the page as shown at the right. Which way is the current passing through the wire?

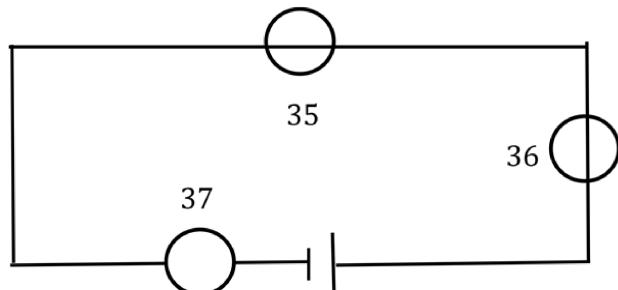


- a) North    b) South    c) Up    d) Down    e) East    f) There is no current

Use the compass directions "a" through "f" illustrated below to answer questions #35-37



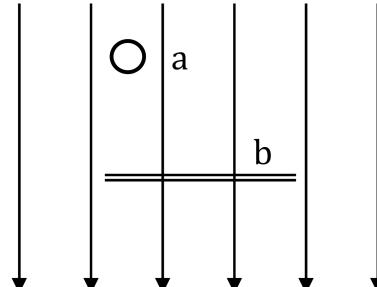
35-37 In the circuit shown at the right, a compass is placed either above or below the wire at the points indicated by #35, 36 and 37. Which way will the compass point in each case?



**Use the following answers for questions #38 - 41.**

- a) North b) South c) East d) West e) Up f) Down g) None

38. In the drawing at the right the magnetic field is acting to the South. What is the direction of the force on wire "a" if the current (electron flow) is going Down into the page?



39. In the drawing at the right the magnetic field is acting to the South. What is the direction of the force on wire "b" if the current (electron flow) is going East?

40. In the drawing at the right the magnetic field is acting into the page. What would be the direction of the force on an electron that is moving to the East?

X X X X X

X X X X X

41. In the drawing at the right the magnetic field is acting into the page. What would be the direction of the force on a proton that is moving to the South?

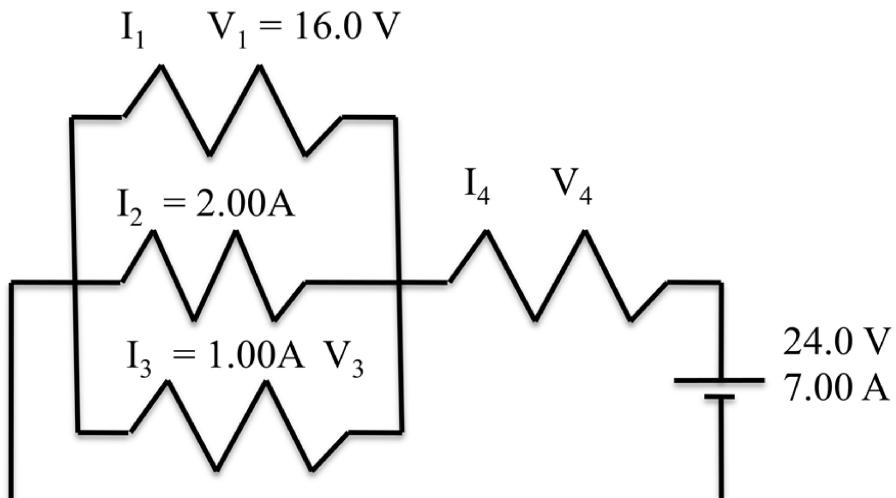
X X X X X

X X X X X

Use the drawing at the right to answer questions #42 - 45

42. What is  $I_1$ ?

- a) 1.00 A  
b) 2.00 A  
c) 3.00 A  
d) 4.00 A  
e) 7.00 A



43. What is  $V_3$ ?

- a) 4.0 V      b) 8.0 V      c) 16.0 V      d) 24.0 V      e) 40.0 V

44. What is  $I_4$ ?

- a) 1.00 A      b) 2.00 A      c) 3.00 A      d) 4.00 A      e) 7.00 A

45. What is  $V_4$ ?

- a) 4.0 V      b) 8.0 V      c) 16.0 V      d) 24.0 V      e) 40.0 V

Use the drawing at the right to answer questions #46 – 50.

46. What is the current passing through Resistor  $R_3$ ?

a) 1.00 A  
b) 2.00 A  
c) 4.00 A  
d) 7.50 A  
e) 4.00  $\Omega$

47. What is the voltage drop across Resistor  $R_3$ ?

a) 30.0 V      b) 16.0 V      c) 8.0 V      d) 6.00 V      e) None of these.

48. What is the current passing through the battery?

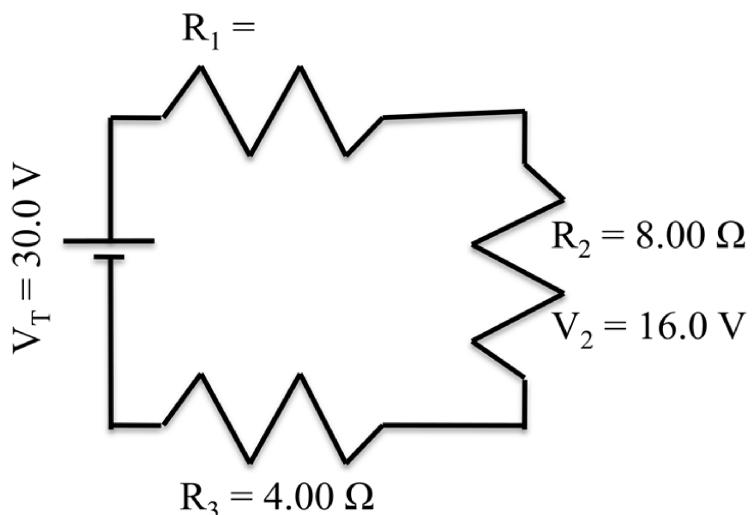
a) 1.00 A      b) 2.00 A      c) 4.00 A      d) 7.50 A      e) None of these.

49. What is the voltage drop across resistor  $R_1$ ?

a) 30.0 V      b) 16.0 V      c) 8.0 V      d) 6.00 V      e) None of these.

50. What is the total resistance of the external circuit?

a) 4.00  $\Omega$       b) 12.0  $\Omega$       c) 15.0  $\Omega$       d) 30.0  $\Omega$       e) None of these.



$$R_3 = 4.00 \Omega$$

$$R_2 = 8.00 \Omega$$

$$V_2 = 16.0 \text{ V}$$

NATIONAL SCIENCE OLYMPIAD 2013 ~ DIVISION B: SHOCK VALUE

SCHOOL \_\_\_\_\_ TEAM #: B \_\_\_\_\_

STUDENT NAMES: \_\_\_\_\_

***PRINT CLEARLY!*** \_\_\_\_\_

**PART #1 - GENERAL QUESTIONS ON ELCCTRICITY & MAGNETISM** SOME OF  
THESE MAY HAVE MORE THAN ONE ANSWER. THERE IS NO PARTIAL CREDIT, BUT THE FINAL TIE  
BREAKER WILL BE THE MOST CORRECT MULTIPLE ANSWER QUESTIONS.

- |     |   |   |   |   |   |   |   |   |   |   |   |  |
|-----|---|---|---|---|---|---|---|---|---|---|---|--|
| 1.  | a | b | c | d |   |   |   |   |   |   |   |  |
| 2.  | a | b | c | d | e | f | g |   |   |   |   |  |
| 3.  | a | b | c |   |   |   |   |   |   |   |   |  |
| 4.  | a | b | c |   |   |   |   |   |   |   |   |  |
| 5.  | a | b | c |   |   |   |   |   |   |   |   |  |
| 6.  | a | b | c | d |   |   |   |   |   |   |   |  |
| 7.  | a | b | c |   |   |   |   |   |   |   |   |  |
| 8.  | a | b | c | d | e |   |   |   |   |   |   |  |
| 9.  | a | b | c |   |   |   |   |   |   |   |   |  |
| 10. | a | b | c |   |   |   |   |   |   |   |   |  |
| 11. | a | b | c |   |   |   |   |   |   |   |   |  |
| 12. | a | b | c |   |   |   |   |   |   |   |   |  |
| 13. | a | b | c | d | e | f | g | h | i | j | k |  |
| 14. | a | b | c | d | e | f | g | h | i | j | k |  |
| 15. | a | b | c | d | e | f | g | h | i | j | k |  |
| 16. | a | b | c | d | e | f | g | h | i | j | k |  |
| 17. | a | b | c | d | e | f | g | h | i | j | k |  |
| 18. | a | b | c | d | e | f | g | h | i | j | k |  |
| 19. | a | b | c | d | e | f | g | h | i | j | k |  |
| 20. | a | b | c | d | e | f | g | h | i | j | k |  |
| 21. | a | b | c | d | e |   |   |   |   |   |   |  |
| 22. | a | b | c | d | e | f | g |   |   |   |   |  |

23. a b c d e
24. a b c
25. a b c d
26. a b c d e
27. a b c d
28. a b c d
29. a b c d e f
30. a b c d e f
31. a b c d e f
32. a b c d e f
33. a b c d
34. a b c d e f
35. a b c d e f
36. a b c d e f
37. a b c d e f
38. a b c d e f g
39. a b c d e f g
40. a b c d e f g
41. a b c d e f g
42. a b c d e
43. a b c d e
44. a b c d e
45. a b c d e
46. a b c d e
47. a b c d e
48. a b c d e
49. a b c d e
50. a b c d e

**PART #1 POINTS**

**/50**

# NATIONAL SCIENCE OLYMPIAD 2013 ~ DIVISION B: SHOCK VALUE

SCHOOL \_\_\_\_\_ TEAM #: B \_\_\_\_\_

## PART 2: LAB EXERCISES.

1. Before you is a breadboard with a single circuit involving many resistors of three (3) distinct values. **THERE IS TAPE COVERING EACH RESISTOR EXCEPT ONE. DO NOT TRY TO REMOVE THE TAPE AND DO NOT REMOVE ANY OF THE RESISTORS!** (24 POINTS) FIRST TIE BREAKER.

In my storeroom I had the following types of resistors, but I only used three types of these in this circuit. Find and list the values of each resistor in the spaces below.

Brown Green Black Gold  
Red Red Black Gold  
Orange Orange Black Gold  
Yellow Violet Black Gold

Green Blue Black Gold  
Brown Black Brown Gold  
Red Red Brown Gold

THIS IS HOW THE RESISTORS ARE ARRANGED ON THE BREADBOARD.

$R_4$	$R_6$	$R_7$	$R_{10}$
$R_3$	$R_5$	$R_9$	$R_{12}$
$R_2$	$R_8$		$R_{11}$
$R_1$			

**LIST YOUR ANSWERS BELOW (TWO POINTS EACH).**

$R_1 =$                                    $R_7 =$

$R_2 =$                                    $R_8 =$

$R_3 =$                                    $R_9 =$

$R_4 =$                                    $R_{10} =$

$R_5 =$                                    $R_{11} =$

$R_6 =$                                    $R_{12} =$

**TURN THE PAGE OVER FOR #2**

**DO NOT MOVE ANY OF THE WIRES OR CHANGE THE POSITION OF  
ANY OF THE SWITCHES!**

2. Before you is a circuit with switches. identical light bulbs and a battery holder. Draw a schematic of the circuit as if the following were true. There are batteries in both holders that were wired properly in series. SECOND TIE BREAKER. (CIRCUIT 19 POINTS)
- There is a voltmeter placed to measure the voltage drop across Bulb #1.
  - There is an ammeter placed to measure the current passing through just bulb #1.
  - There is an ammeter placed to measure the current passing through just bulb #3.

Assuming that there are batteries in the battery holders and initially all the bulbs are lit, circle the correct answer for each of the following questions. (one point each)

IN THE SYSTEM SHOWN, WHICH BULB(S) WILL BE THE BRIGHTEST?

- a) Bulb #1    b) Bulb #2    c) Bulb #3    d) Bulb #2 & 3    e) All are the same.

IF ONLY SWITCH #1 IS OPENED, WHAT WILL HAPPEN TO THE CURRENT IN EACH BULB?

- |         |            |             |                  |                   |
|---------|------------|-------------|------------------|-------------------|
| Bulb #1 | a) Go to 0 | b) Decrease | c) Stay the same | d) Become greater |
| Bulb #2 | a) Go to 0 | b) Decrease | c) Stay the same | d) Become greater |
| Bulb #3 | a) Go to 0 | b) Decrease | c) Stay the same | d) Become greater |

IF ONLY SWITCH #2 IS CLOSED, WHAT WILL HAPPEN TO THE BRIGHTNESS OF EACH BULB?

- |         |           |                  |                  |                    |
|---------|-----------|------------------|------------------|--------------------|
| Bulb #1 | a) Go out | b) Become dimmer | c) Stay the same | d) Become brighter |
| Bulb #2 | a) Go out | b) Become dimmer | c) Stay the same | d) Become brighter |
| Bulb #3 | a) Go out | b) Become dimmer | c) Stay the same | d) Become brighter |

Team Member: \_\_\_\_\_

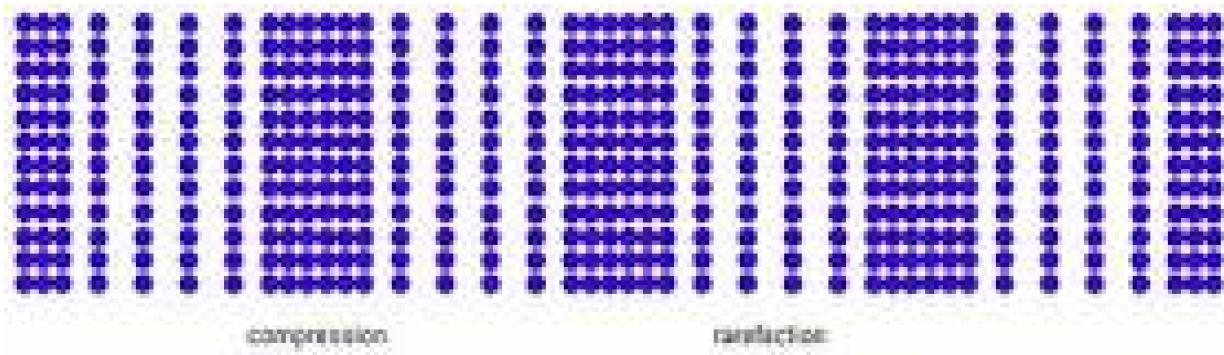
Team number \_\_\_\_\_

Team Member: \_\_\_\_\_

State \_\_\_\_\_

School Name: \_\_\_\_\_

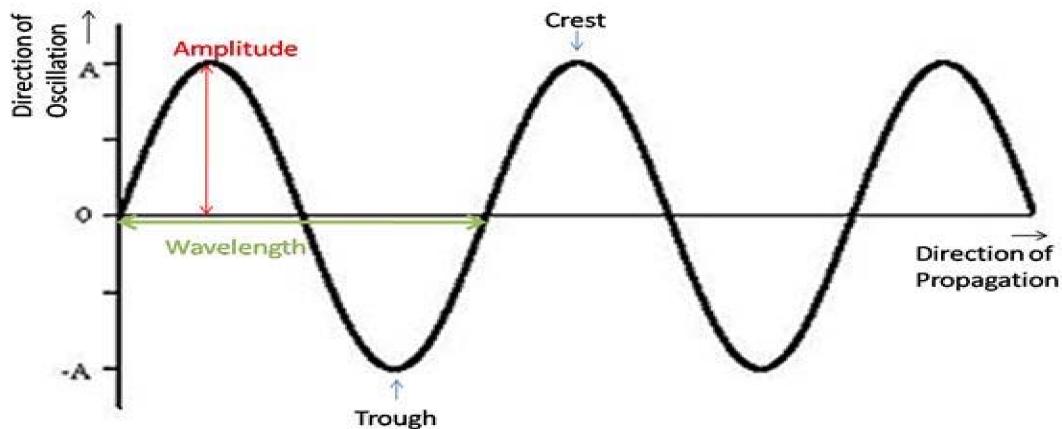
QUESTION 2: FILL IN EACH LINE WITH THE PROPER TERM. THEN, CIRCLE EXACTLY ONE WAVELENGTH OF EACH WAVE.



1. \_\_\_\_\_

2. \_\_\_\_\_

3. General name for the type of wave drawn above: \_\_\_\_\_



4. General name for the type of wave drawn above: \_\_\_\_\_

(One point for each line,  $\frac{1}{2}$  point for each correctly-circled wavelength) Note: The diagram answers will be out!

# Each of the following questions will be interviewed.

QUESTION 1: Describe the physics of your particular instrument.

1 point for how it makes sound

2 points for how the construction of the device affected the performance of the instrument.

1 point for how the sound's loudness is changed

1 point for how the sound's frequency is changed.

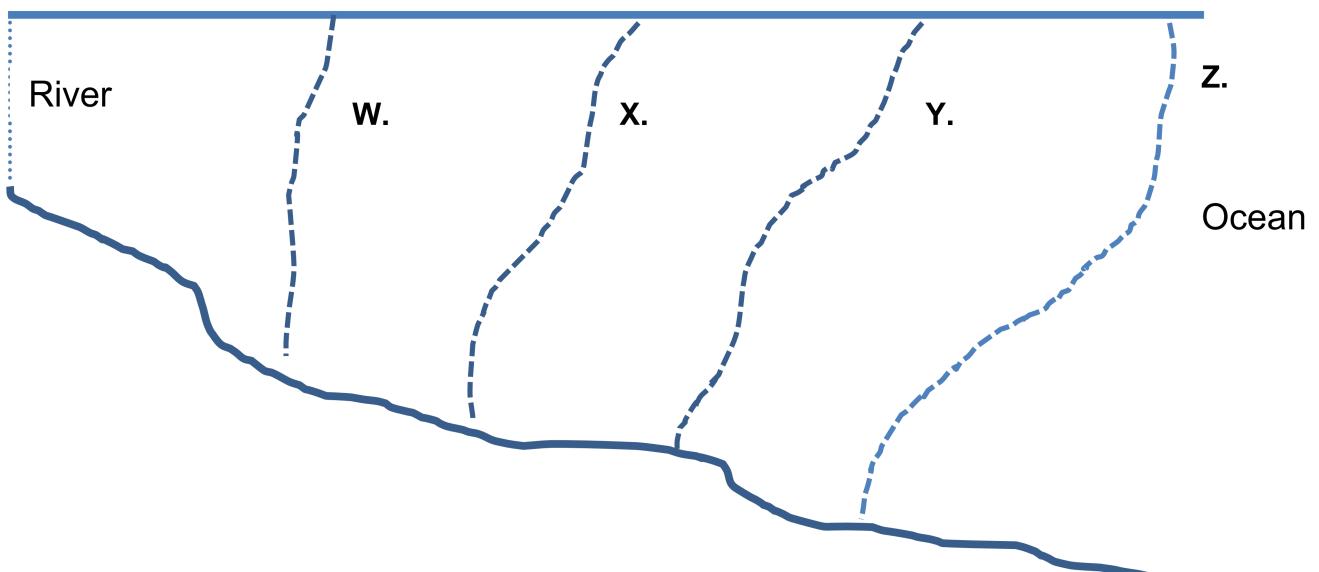
QUESTION 3: In front of you are two sound boxes, each with a tuning fork. Each tuning fork is struck. (Beat frequencies are heard and pointed out so that it is clear that the competitors know what I am showing them.)

- a) Name the phenomenon you are hearing. Two points for identifying beats.
- b) The beats have their own frequency. How is this frequency related to the frequencies of the two tuning forks? (Answer: The frequency of the beats equals the difference between the frequencies of the two tuning forks.)  
Three points.

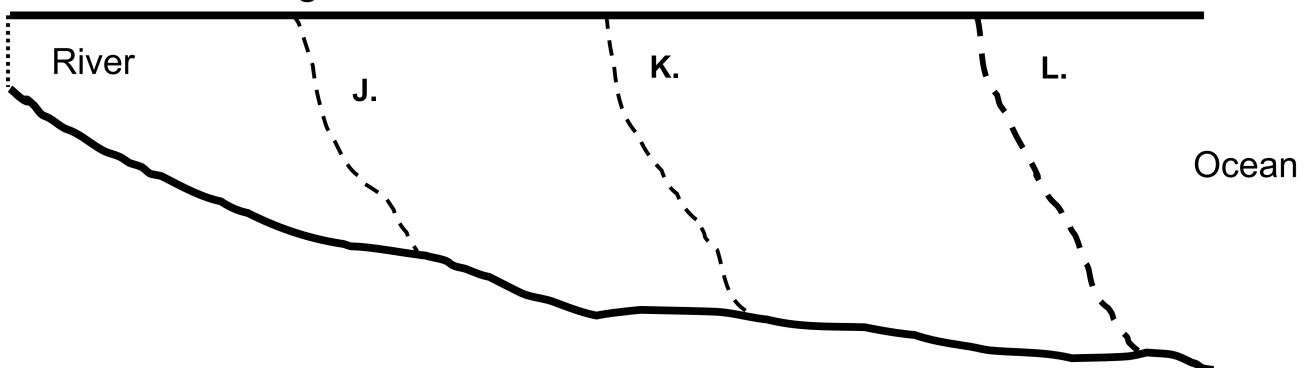
QUESTION 4: In front of you is a Pringle can 2/3 full of water and a piece of PVC pipe. I strike a tuning fork (frequency deliberately hidden!) and hold it above the PVC pipe. As I lift the PVC pipe and tuning fork together, the sound changes.

- a) At the point where the sound is loudest, the length of the PVC pipe above the water equals what portion of the wavelength of the sound? (Answer:  $\frac{1}{4}$ ) Two points
- b) In order to determine the unknown frequency of the tuning pipe from this experiment, what other data would I need to gather, besides the length of the PVC above the water? (Answer: the speed of sound in the room, at the current air temperature in the room.) Three points.

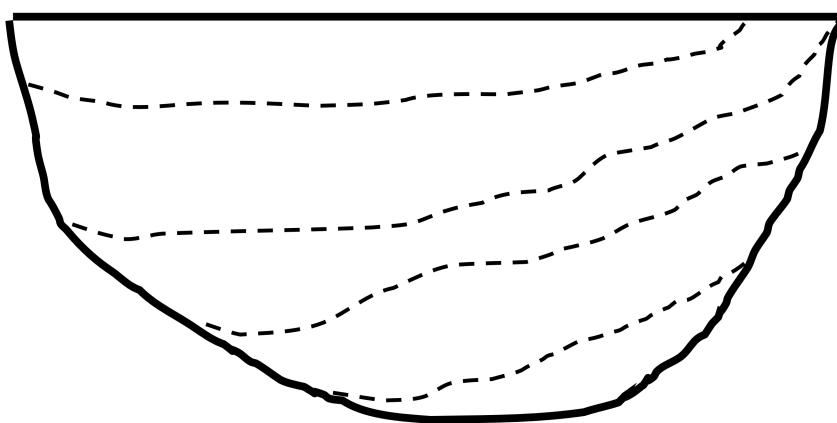
Station 5 – Figure 1



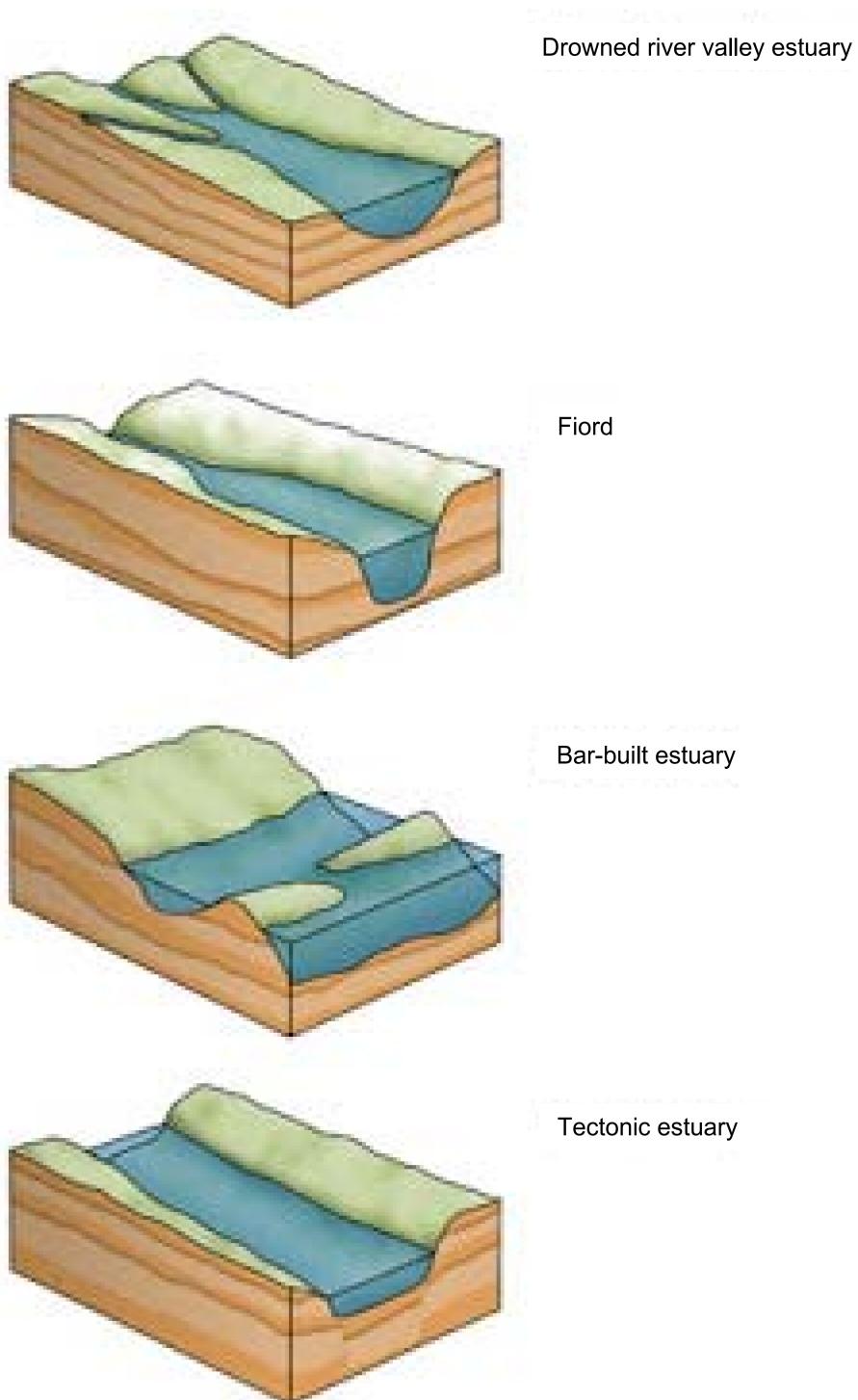
Station 5 – Figure 2



Station 5 – Figure 3



## Station 5 – Figure 4



## **Station 1**

1. What is the foremost global water quality issue?
2. The federal legislative act that is at the cornerstone of this country's water pollution control efforts is called the 1972 \_\_\_\_\_.
3. Too much \_\_\_\_\_ can cause excess algae, which in turn uses up large amounts of oxygen and causes aquatic organisms as well as fish to die.
  - a. Chlorine
  - b. Acidity
  - c. Phosphates
  - d. Nitrates
4. The environmental condition noted in the previous question, especially with regards to lakes, is called \_\_\_\_\_.
5. In the most generic terms, what type of organism occupies the first trophic level in a food chain?
6. What are the two fundamental functions/services of the first trophic level that influences all subsequent trophic levels?
7. In March of this year, the City of Shanghai was confronted with a “gross” major water pollution incident in the Huangpo River that was in the international news for several days. Very briefly describe this event.
8. What is the single largest consumptive use of freshwater in the world (and it's not drinking water)?
9. Normal rain is slightly acidic because \_\_\_\_\_ dissolves into it forming a weak acid.
10. This weak acid (from the previous question) results in “average” rain having a pH of approximately \_\_\_\_\_ at typical atmospheric conditions.
  - a. 6.3
  - b. 7.0
  - c. 5.6
  - d. 8.1
11. Where in a stream would you find “periphyton”?

12. Which of the following fresh water benthic organisms – as a group - would be considered to be most endangered in North America?

- a. Stoneflies
- b. Dragonflies
- c. Crayfish
- d. Mussels
- e. Freshwater snails

13. When “nutrients” are referenced in connection with water quality issues/problems, what specific parameters are being referred to?

14. \_\_\_\_\_ is specifically required by all living plants and animals for building proteins.

- a. Carbon Dioxide
- b. Nitrogen
- c. Oxygen
- d. Hydrogen

15. Giardia is:

- a. A type of water crustacean
- b. A chemical for treating drinking water
- c. An invasive fish found in the Great Lakes
- d. A waterborne disease
- e. A device for collecting water samples

## **Station 2**

***Note: Please note that some of these questions are about water treatment (for consumption) and some are about wastewater treatment; don't confuse the two.***

1. Older communities have sewers that were designed to carry both storm water and sanitary waste. Such sewers are referred to as \_\_\_\_\_ sewers
2. The most common chemical used by municipalities to disinfect drinking water is \_\_\_\_\_.
3. Many water treatment plants add \_\_\_\_\_ as an aid to prevent tooth cavities.
4. Activated carbon (AC) is used in both the treatment of drinking water and wastewaters, almost always in very specialized circumstances involving organic chemicals. The process by which AC reduces these contaminants is:
  - a. Filtration
  - b. Adsorption
  - c. pH adjustment
  - d. chemical neutralization
5. Within the Safe Drinking Water Act, numerical limits are established for Primary Standards and Secondary Standards. Describe in very general terms the difference between the two.
6. Primary wastewater treatment uses:
  - a. a series of digestive and fermentative reactions.
  - b. physical separation methods to separate solid and particulate organic & inorganic materials from waste water.
  - c. digestive reactions carried out by microorganisms under aerobic conditions to treat wastewater.
  - d. physiochemical or biological process employing bioreactors, precipitation, filtration, or chlorination procedures similar to those employed for drinking water purification.
7. In many water treatment plants, chemicals are added to get extremely small particles to stick together to form larger particles that will be easier to separate. This process is called \_\_\_\_\_.
8. Following the process in the previous question, the water is stirred very gently to encourage the larger particles to clump together and form even larger particles. This part of the treatment process is called \_\_\_\_\_.

9. Water plants might use lime/soda treatment or ion exchange (never both) to reduce what common, non-harmful constituent found in much of the nation's drinking water?
10. \_\_\_\_\_ is a process used in both water and wastewater treatment plants to remove large debris (fish, sticks, logs, trash) that might otherwise damage plant equipment.
11. Many homes (and small businesses) that are not connected to central sewers instead use an on-site system to dispose of sewage consisting of a
  - (a.) \_\_\_\_\_ followed by a
  - (b.) \_\_\_\_\_.
12. The semi-solid residue created by the biological processes of wastewater treatment is called \_\_\_\_\_. (The same term applies to the inorganic residue at water plants.)
13. This residue (from the previous question) can be disposed of in a variety of ways. Which of the following is not a way in which this material can be properly disposed?
  - a. Incineration
  - b. Taken to a landfill
  - c. Application to farm fields
  - d. Application to livestock pasturage
  - e. Bagged and sold as a soil/garden supplement
14. Many wastewater plants are required to reduce levels of ammonia in their discharge. Reduction of ammonia would be what part of the nitrogen cycle?
  - a. Nitrification
  - b. Denitrification
  - c. Fixation
  - d. Mineralization
  - e. Demineralization
15. Which of the following processes is not part of a conventional municipal wastewater plant?
  - a. Post-aeration
  - b. Recarbonation
  - c. Screening
  - d. Grit removal
  - e. Sludge wasting

## **Station 3**

1. You have collected two samples to be tested for pH. Sample A has a result of 4.0. Sample B yields a result of 6.0. Which sample is the more acidic?
2. Referring to the samples in the previous question, one sample is how much more acidic than the other sample?
3. There are many ways to measure pH. Place the following four methods in order from least to most accurate: Hydron paper; Colorometric titration; Electronic probe; Litmus paper.
4. The occurrence of a pH problem in a stream is most likely to occur in conjunction with which of the following activities?
  - a. Mining of sand and gravel
  - b. Electrical generation
  - c. A large livestock operation
  - d. Coal mining
5. The device pictured at right is called a(n) \_\_\_\_\_.



6. This device is associated with what parameter from the Water Quality event description?
7. Low levels of mercury are found in the majority of streams in this country. The largest source of this mercury is from what activity?
8. During what period of the year would you expect the phosphate loading in a typical stream to be the highest?
  - a. Spring
  - b. Summer
  - c. Fall
  - d. Winter
9. This peak phosphorus loading (from the previous question) is associated with what seasonal human activity?
10. Methemoglobinemia is a disease/condition that can impact the health of small infants and the elderly. It is associated with the presence of which of the parameters (identified in the event description) found in drinking water?